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# Improved Routing Protocol Using Hybrid Ant Colony Optimization and Particle Swarm Optimization

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**Abstract:** The principle problem of QoS routing would be to setup a new multicast hierarchy that may meet specific QoS concern. In order to lessen the constraints of the earlier work a whole new improved approach is proposed with this exertion. Inside of proposed technique the challenge of multi-cast sapling is removed using clustering primarily based technique. For starters multi-radio along with multichannel primarily based clustering will be deployed along with these bunch head have the effect of the multicasting. It's going to diminish the general energy consumption of nodes along with complexity of intelligent algorithms. The way will end up being evaluated based upon the ish colony marketing. Thus they have produced better results in comparison with other strategies.

**Keywords:** QoS, Multicast, Ant colony optimisation, clustering.

## I. INTRODUCTION

A Cell Adhoc Network is an accumulation associated with independent portable nodes that may communicate with each other via radio waves. The mobile nodes which are in radio range of each other can directly communicate, whereas others need the assistance of intermediate nodes to route their packets. All the nodes has a wireless interface to speak with each other. These kinds of networks tend to be fully distributed, and perform on anywhere without the help of any predetermined infrastructure seeing that access factors or starting stations. Figure 1 shows a fairly easy ad-hoc network with 3 nodes. Node 1 and node 3 are not within range of each other, nevertheless the node 2 may be used to forward packets between node 1and node 2. The node 2 will behave as a switch and these three nodes together form an ad-hoc network.

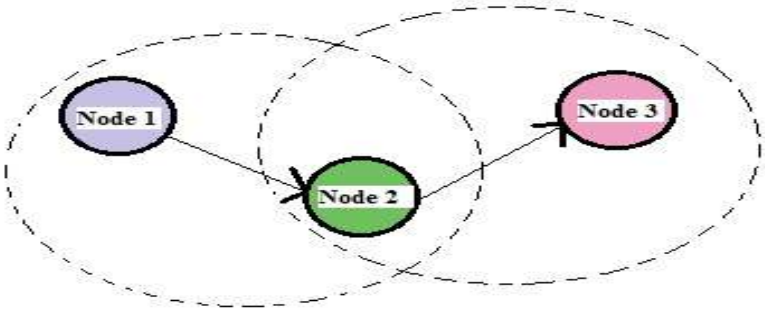


**Fig.1 Example of mobile ad-hoc network**

### 1.1 FEATURES OF MANETS

1. Distributed operation: There's no background network for the central control of the network operations, the control of the network is distributed on the list of nodes. The nodes involved in a MANET should cooperate with each other and talk among themselves and every single node acts as an exchange seeing that needed, to carry out specific functions for instance routing and security.
2. Multi hop routing: Each time a node tries to send information to other nodes which can be out of its communication range, the packet should be forwarded via a number of intermediate nodes.
3. Autonomous fatal: In MANET, each portable node is an unbiased node, which can work seeing that both a bunch and any router.
4. Dynamic topology: Nodes are free to go arbitrarily with various speeds; thus, the network topology may change aimlessly and from unpredictable time period. The nodes in the MANET dynamically establish routing among themselves while they travel around, establishing their particular network.
5. Light-weight terminals: In maximum cases, the nodes at MANET tend to be mobile using less Processor capability, low power storage devices and smaller memory measurement. Shared
6. Real Medium: The wifi communication medium can be purchased to just about any entity using the right gear and satisfactory resources. Appropriately, access towards the channel can't be restricted.

### 1. 2 ATTRIBUTES OF MANETS

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Why people love an Ad-Hoc network add the following:
• They feature access to help information in addition to services irrespective of geographic location.
• Liberty from middle network administration. Self-configuring community, nodes can also be act as routers. Less expensive compared to wired community.
• Scalable—accommodates the actual addition connected with more nodes.
• Improved upon Flexibility.
• Robust as a result of decentralize administration.
• The particular network can be set up from anywhere and time.

1. 3 APPLICATIONS ASSOCIATED WITH MANETS

Some of the typical purposes include:

1) Armed service battlefield: Ad-Hoc marketing allows the actual military to make the most of commonplace community technology and keep an facts network involving the soldiers, cars, and army information mind quarter.

2) Collaborative operate: For a few business surroundings, the requirement for collaborative computing might be more crucial outside company environments in comparison with inside in addition to where men and women do must have outside conferences to directly and exchange facts about confirmed task.

3) Regional level: Ad-Hoc communities can autonomously website link an quick and non permanent multimedia community using notebook computers to propagate and reveal information involving participants with a e. grams. Conference or even classroom. Another suitable local stage application might be in property networks where by devices can communicate on to change facts.

4) Private area community and Wireless: A individual area network is often a short variety, localized community where nodes are often of a given person. Short-range MANET including for illustration Bluetooth can simplify the actual inter conversation between several cellular devices for instance a laptop, and also a mobile cell phone.

5) Business oriented Sector: Ad hoc can be employed in emergency/rescue operations for disaster relief work, e. grams. in hearth, flood, or even earthquake. Emergency recovery operations must occur where non-existing or even damaged marketing and sales communications infrastructure in addition to rapid deployment of a communication network is required

**1.3MANETS ROUTING PROTOCOLS**

Ad-Hoc circle routing protocols are commonly divided into about three main classes; Proactive, reactive and cross protocols as found in figure 2.

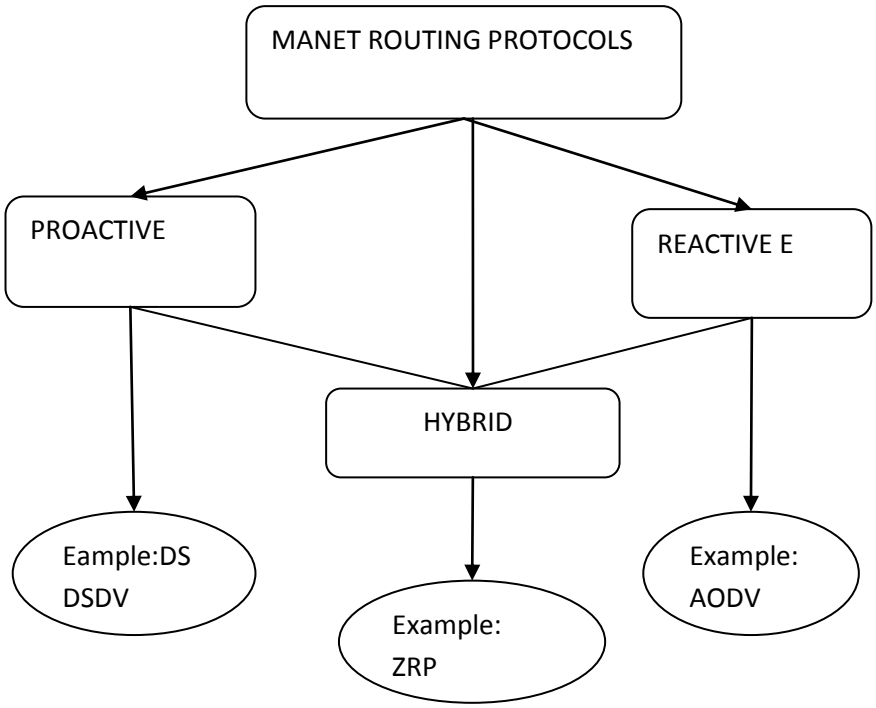


**Fig 2: Classification of MANET routing protocol**

1) **Proactive Protocols:** Proactive, or table-driven routing protocols. In positive routing, each node needs to maintain a number tables to shop routing information, and any alterations in network topology have to be reflected by propagating updates through the entire network to be able to maintain a regular network view. Example of such schemes include the conventional routing techniques: Destination sequenced mileage vector (DSDV). They attempt to maintain consistent, up-to-date routing information in the whole network. It minimizes your delay in communication and invites nodes to rapidly determine which nodes are present or reachable within the network.

**Example:** Destination-sequenced distance vector (DSDV), Wireless routing protocol (WRP), Global state routing (GSR), OLSR (Optimized Link State Routing)

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**Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)**

The protocol Destination-Sequenced Distance-Vector routing (DSDV) is a Proactive routing protocol that solves the significant problem related to distance vector routing of wired networks i.e., Count-to-infinity, by utilizing destination sequence number. In this routing protocol, each mobile node in the network keeps a routing table. The entire routing table provides the list of available destinations and the amount of hops to each. Each table entry is tagged with a routine number that will be originated by the destination node. Periodic transmissions of updates of the Routing tables help maintaining the topology information of the network. When there is any new significant change for the routing information, the updates are transmitted immediately. So, the routing information updates might either be periodic or event driven the routing updates could possibly be submitted two ways: one is known as a ‘‘full dump" and another is ‘‘incremental.' 'In case there is full dump, the entire routing table is delivered to the neighbors, where as in case of incremental update, only the entries that require changes are sent.

**Wireless Routing Protocol (WRP)**

This routing protocol defined whilst the group of distributed shortest path algorithms that calculate the paths using information concerning the length and second-to-last hop of the shortest way to each destination. WRP reduces the amount of cases where a temporary routing loop can occur. For the purpose of routing, each node maintains four things: 1. A distance table 2. A routing table 3. A link-cost table 4. A note retransmission list (MRL). WRP uses periodic update message transmissions to the neighbors of a node. Each time the consistency of the routing information is checked by each node in this protocol, which supports to eliminate routing loops and always tries to find out the best solution for routing in the network.

**Global State Routing (GSR)**

In GSR protocol [6], nodes exchange vectors of link states among their neighbors during routing information exchange. Based on the link state vectors, nodes maintain a global knowledge of the network topology an optimize their routing decisions locally. Functionally, this protocol resembles DSDV, but it improves DSDV in the sense that it avoids flooding of routing messages.

**2) Reactive Protocols:** Reactive routing is also called on-demand routing protocol since they just don't maintain routing data or routing activity on the network nodes when there is no communication. If a node would like to send a packet completely to another node then this protocol pursuit of the route within the on-demand manner and establishes the connection to be able to transmit and receive the packet. The route finding occurs by inundating the route request packets through the entire network. Examples of reactive routing protocols include the Ad-hoc On-demand Range Vector routing (AODV) and Dynamic Source routing (DSR).

**Ad-Hoc On-Demand Distance Vector (AODV) Routing Protocol**

AODV is variation of Destination-Sequenced Distance-Vector (DSDV) routing protocol . AODV is absolute of Bellman-Ford Algorithm. It is a amalgamation of DSR and DSDV approach. It inherits the basic on demand mechanism of route discovery and route maintenance approach from DSR and hop by hop routing sequence .It works to minimize the requirement of system wide broadcasts to its extreme. The algorithm use by AODV is explained below.

**Three main control messages are used by AODV**

1. Routing Request

When a route is not available to given destination a route request packet (RREQ) is flooded to whole network

2. Routing Reply

If a node has valid route to destination it will unicast a route reply message (RREP) to the source

3. Route Error

When a node in given route gets lost or path breaks, the nodes on both sides on the given link issue a route error message (RERR) to their end nodes.

**Benefits:-**

1) Highly Adaptable to dynamic networks.
2) Lower setup delay is necessary for connections and detection of latest routes.
3) Favors the smallest amount of congested routes over shortest routes.
4) Supports both unicast and multicast packet transmissions for nodes in constants movement.
5) Adopts traditional routing tables: one entry per destination in contrast to DSR which preserves multiple route cache entries for each destination
6) Responds quickly to topological changes.
7) Does not put additional overheads on data packets, as it generally does not make use of source routing [1].

**Limitations:-**

1) Requires periodic updates as source sequence number is very old leading to inconsistent.
2) Unnecessary bandwidth consumption as a result of periodic beaconing.

3) It expects/required that the node in the broadcast medium can detect one another broadcasts. Thus expiration and determination of valid route is difficult.
4) Due to network congestion or the fluctuating characteristics of wireless links, route discovered may no more be optimal.
5) AODV is susceptible to various attacks as it is based on the assumption that nodes must co-operate and without their co-operation no route can be established.

**Dynamic Source Routing (DSR) protocol**
This protocol requires each transmitted packet to transport the full address from the foundation to the destination likewise the mechanism used in AODV. It [10] uses shortest hop path from the foundation to the destination. Thus, the foundation learns multiple approaches to the destination and stores them in the route cache. It doesn't check for node disjoint or link disjoint properties before using these routes. DSR fits into the group of routing protocols cantered on minimum weight path routing.
**3) Hybrid Protocols:** They feature a hybrid type that combines reactive and proactive routing standards. The Zone Course-plotting Protocol (ZRP) is often a hybrid routing process that divides your network into areas and specific zones. ZRP provides any hierarchical architecture where by each node needs to maintain additional topological data requiring extra memory space.
Example: Zone routing protocol (ZRP), Distributed dynamic routing (DDR)

## II. RELATED WORK

In this chapter, we studied about various routing protocols of mobile adhoc networks such as AODV, DSR, Cluster based routing protocols, ZRP, DSDV, FSR, etc. Most previous adhoc networks research has focused on problems such as routing and communication. There are many algorithms which are used to enhance the performance and efficiency of the routing protocols such as Ant Colony algorithm, particle swarm algorithm, QoS based algorithms and so on. The related work is classified into various categories such as dynamic routing protocols, static routing protocols, comparisons of various routing protocols; cluster based routing protocols, multicast routing protocols, etc.

**Rajeev Agrawal(2001) [1]** adopted probabilistic modeling to model the effect due to multipath fading and shadowing. The BER for each link affected by the fading is estimated using the proposed model. Wireless Routing Protocol (WRP) maintains the BER associated with a particular link, a packet/ data is routed with optimum BER route from a set of discovered route by protocol. It was found that the proposed model is capable of reducing the number of retransmission for the packet, saves battery energy and also reducing overloading of a particular path by routing the packet through an optimal path (in terms of BER).
**B.Malarkodi et al. (2009) [2]** the impact of different mobility models on Multicast Routing Protocols. The results showed that the throughput of ADMR is higher than of ODMRP at high mobility. This is achieved at the cost of increase in delay and transmission over head. Under low mobility, ODMRP has higher throughput than AMDR. Among the three mobility models considered, the throughput of ODMRP was the highest at low mobility. The results showed that the protocols performances vary widely across the different mobility models.
**V.A Gajbhiye and R. W.Jasutkar(2013) [3]** showed that Swarm Intelligence based routing protocol has shown promising results in VANET. For this they compared and evaluated the performance of AODV, OLSR, and Swarm Intelligence based routing protocol in terms of throughput, latency and data packet delivery ratio for VANET. Simulation results have shown that SWARM Intelligence based routing protocol showed promising results in VANETs as compared to AODV and OLSR.
**Nathaniel Gemelli et al. (2003) [4]** Introduced Bluetooth wireless technology, examine current routing protocols and present the objectives and considerations for the design of a new Bluetooth routing protocol. The protocol design would consider the capabilities of the devices (nodes) within the range of the network. It was envisioned that capabilities Aware Routing (CAR) protocol would make routing decisions based on such. Factors as device power constraints. Memory, Location and signal strength.
**E.Ahila Devi and K.Chitra(2014 )[5]** introduced a Privacy Protecting Secure and Energy Efficient Routing Protocol (PPSEER) was proposed. In this protocol, first the classifications of network node take place based on their energy level. After that encryption was done based on group signature. It includes additional secure parameter such as secret key and maximum transmission power which was known only to the sender and recipient node. The advantage of the proposed routing protocol was that it increases privacy of the message as well as it maintains the energy efficiency of the node.
**Hiba Hachichi et al. (2011) [6]** created and maintained locally a hierarchy that was well suitable for routing packets in an Ad hoc network. The contribution of this work was mainly based on the construction of a virtual topology where cluster heads and gateways collaborate for searching the destination node. Hence, inter-cluster and intra-cluster routing are jointly used. The Net logo platform has been investigated for constructing in an asynchronous manner a virtual topology. Results showed a significant reduction in the exchanging messages. By comparison to the existing methods, their contribution was also able to find the shortest path between a source and a destination.
**Istikmal et al. (2013) [7]** presented about investigation result of AODV, DSR and DSDV that applied an Ant-algorithm which were AODV-Ant, DSR-Ant, and DSDV-Ant. DSDV represents of proactive routing type protocol based on table driven, while AODV and DSR represents of reactive routing protocol type based on demand. Performance analysis included end to end delay, throughput, routing overhead and hop count for various scenario of node velocity, pause time and network traffic. The result showed that proactive routing protocol could improve performance than the reactive routing protocol and more suitable with Ant-algorithm. However, applied an Ant-algorithm on routing protocol was cause to increased of routing overhead and need more computation of each nodes to resulted the best route.

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**Sikkandar Ali and Vashik Ali et al**. (**2012) [8]** presented routing in wireless mobile ad-hoc networks using Destination Sequenced Distance Vector (DSDV) and Ad-hoc on demand Distance Vector (AODV) protocols. The performance of bandwidth, throughput and packet loss of DSDV and AODV has been modeled under various network configurations and mobility conditions. These mechanics can lead to significant performance differentials. The results were justified through NS-2 simulation.

**Geethu Mohandas(2013) [9]** The Mobile Ad hoc Networks (MANET) are networks with self-configuring capacity of mobile devices interconnected by wireless links. During the last few years, research in various aspects of MANETs has been prominent, prompted mainly by military, disaster relief, and law enforcement scenarios. An instinctive footstep was to take up such location-based operation to MANETS. In various applications, including military and law enforcement, node identities are not virtually as helpful as node locations. In suspicious MANETs, nodes do not even trust each other; hence identities must be hidden. This paper attempted to contribute a study and comparison on routing protocols in mobile ad hoc networks.

**KomalPatel et al. (2006) [10]** proposed a cross layer approach that uses the MAC layer link stability information to improve the routing efficiency. Signal strength of the link was captured from the MAC Layer and used at network layer to predict the future signal strength value using double exponential smoothing model. This information was used to categorize the link as stable or unstable. The proposed MAC Layer aware stable link routing protocol (MACSLR) advertises only those distance vectors whose next hop links are stable. They have simulated the protocol compared its performance with On-Demand Distance Vector[l]and Destination Sequenced Distance Vector [2] protocols. Results showed that for lower average overhead, our protocol delivers higher packet delivery ratio and scales well with mobility.

**Rashmi Rohankar et al**. **(2012) [11]** analyzed the effect of random based mobility models on the performance of Proactive Routing Protocol (DSDV Destination Sequence Distance Vector) and Reactive Routing Protocol (AODV- on Demand Distance Vector, DSR- Dynamic Source Routing). Performance analysis was done with respect to end-to-end delay, throughput and Packet delivery ratio for varying node densities.

**Yudhvir Singh(2010)[12]** performed simulation based experiments were performed to analyzed the performance of On Demand Multicast Routing Protocol by evaluating Packet Delivery Ratio, End to End delay and average throughput. These results were compared with AODV and FSR routing protocols by varying number of nodes and mobility. The comparison showed that ODMRP for ad hoc networks performs better as compared to AODV and FSR.

**T.R. Reshmi et al. [13]** proposed a Trust based dynamic distributed IP addressing method using fuzzy logic rule sets that may detect the misbehaving nodes and select trusted nodes that may serve the IP address to the requesting nodes as all the existing algorithms were mainly designed to meet up the basic necessities of the configuring algorithms like address uniqueness, network merging and partitioning support, Integration with routing protocols etc. These pr4otocols do not think about the impact of misbehaving nodes in the MANETs. The performance of the configuring protocols in MANETs is highly deteriorated by the selfish nodes and overloaded nodes. Selfish nodes are nodes which seek advantages from other nodes, but refuse to fairly share its resource or provide service to other nodes. These selfish nodes and overloaded nodes drop the protocol request packets from other nodes. This affected the standard functioning of the nodes in MANETs during the configuration process.

## III. PROPOSED METHDOLOGIES

### 3.1 Enhanced ACO_PSO Algorithm

Following are the various steps required to successfully simulate the proposed algorithm.

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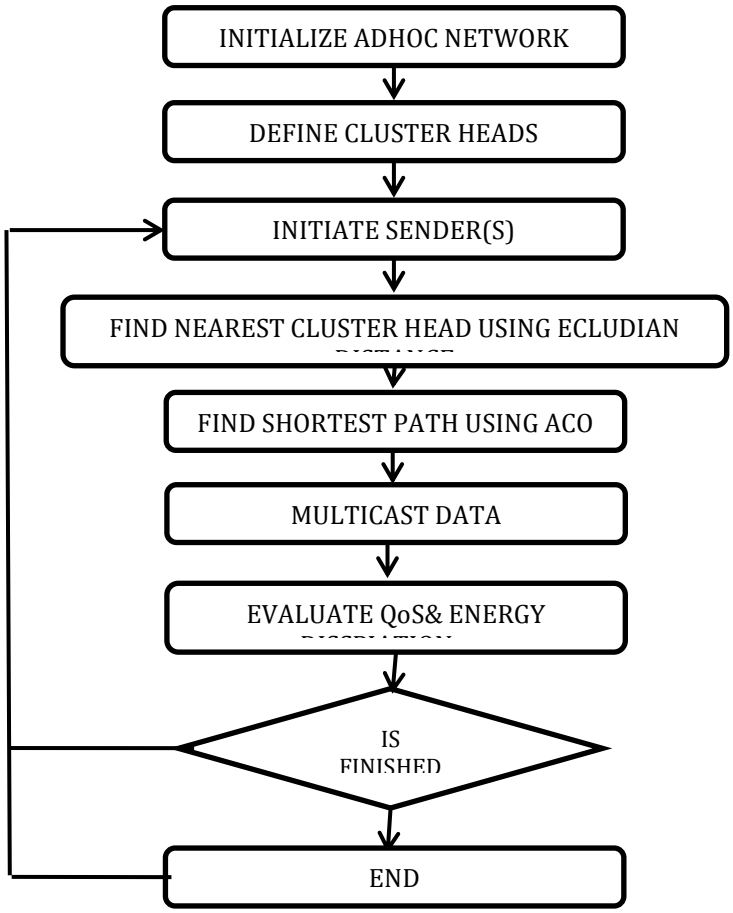


**Fig.1. Flowchart of the proposed technique**

**Step 1:** First of all initialize ad-hoc network with their respective characteristics like moving range, maximum dimensions, number of nodes etc.
**Step 2:** Define cluster heads having multi-radio and multi-channel facility.
**Step 3:** Sender(s) will be initiated to multicast its data to defined nodes.
**Step 4:** Sender will hand over its data to nearest cluster head using Euclidian distance.
**Step 5:** Cluster head will multicast data to available cluster heads depends upon the ACO based shortest path.
**Step 6:** Evaluate energy dissipation as well as other QoS features, and move to step 3
**Step 7:**

## IV. RESULT ANALYSIS

### 4.1 EXECUTION TIME

In Mobile ad hoc network (MANET) consist of mobile hosts without any infrastructure. Here the Execution time is the essential parameter in performance analysis for the research peoples. Execution time is the time for executing a particular scenario.
Table represents the execution time evaluation of proposed technique as compared to existing technique

**Table 1: Execution Time Evaluation**

| No. of nodes | Existing | Proposed |
|---|---|---|
| 25 | 54.2657 | 8.4259 |
| 30 | 54.4737 | 9.4564 |
| 35 | 54.6426 | 11.3063 |
| 40 | 54.9043 | 13.6511 |
| 45 | 55.1138 | 16.2837 |
| 50 | 55.2723 | 20.2192 |
| 55 | 55.66.09 | 24.3742 |

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| | | |
|---|---|---|
| 60 | 55.5970 | 31.8873 |
| 65 | 55.9236 | 35.1945 |
| 70 | 56.3050 | 42.5707 |

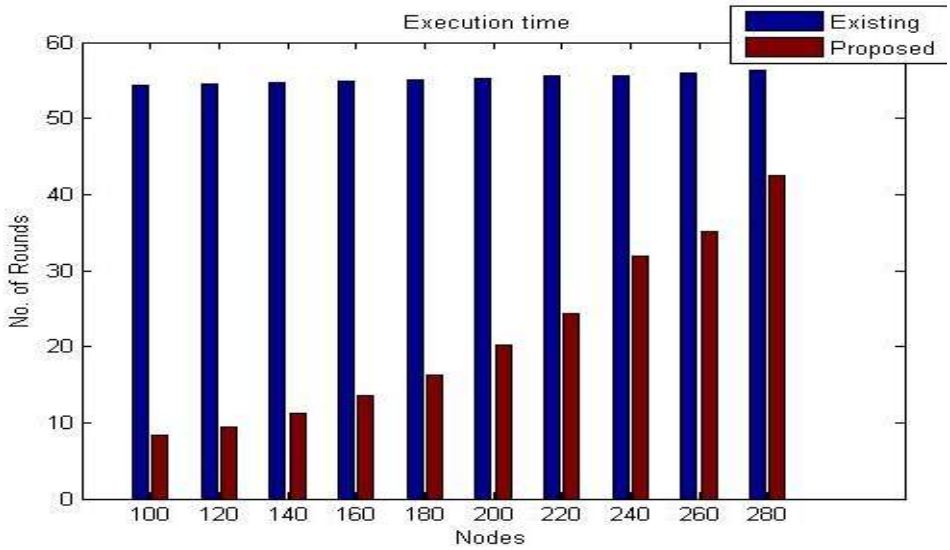


**Fig2: Execution Time Analysis**

Fig2 represents that execution time of proposed technique is less as compared to existing technique. Therefore, proposed work outperforms the existing technique.

### 4.2 TREE DELAY JITTER

The term jitter is often used as a measure of the variability over time of the packet latency across a network. A network with constant latency has no variation (or jitter). Packet jitter is expressed as an average of the deviation from the network mean latency. However, for this use, the term is imprecise. Or in other word jitter is the variation of the packet arrival time. In jitter calculation the variation in the packet arrival time is expected to minimum. The delays between the different packets need to be low if we want better performance in Mobile Ad-hoc Networks.
Table represents the execution time evaluation of proposed technique as compared to existing technique.

**Table 2: Tree Delay Jitter Evaluation**

| No. of nodes | Existing | Proposed |
|---|---|---|
| 25 | 438.5070 | 426.4985 |
| 30 | 508.1668 | 491.7414 |
| 35 | 588.2440 | 532.4638 |
| 40 | 483.8615 | 448.7730 |
| 45 | 550.7022 | 506.6742 |
| 50 | 624.2351 | 537.0313 |
| 55 | 689.5123 | 550.5836 |
| 60 | 705.7873 | 529.2101 |
| 65 | 800.1047 | 579.6533 |
| 70 | 976.0218 | 622.6731 |

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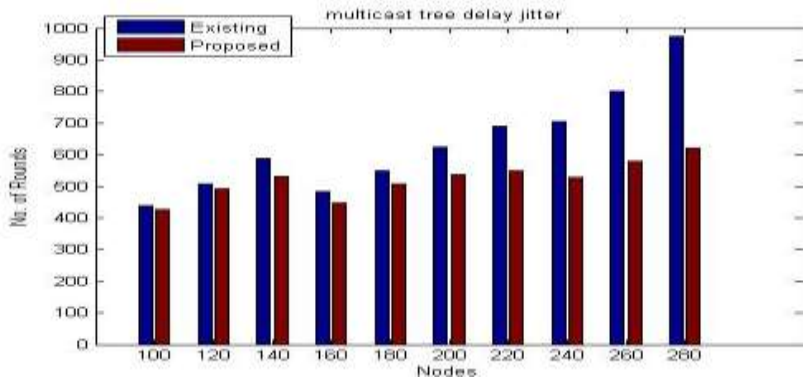


**Fig 3: Delay Jitter Analysis**

Fig3 represents that delay jitter of proposed technique is less as compared to existing technique. Therefore, proposed work outperforms the existing technique.

### 4.3 MULTICAST TREE DELAY

**Delay:** The delay of data packets is the interval between the data packet generation time and the time when the last bit arrives at the destination. Table represents the execution time evaluation of proposed technique as compared to existing technique.

**Table 3: Multicast tree delay Evaluation**

| No. of nodes | Existing | Proposed |
|---|---|---|
| 25 | 418.0726 | 384.2413 |
| 30 | 453.6931 | 450.2851 |
| 35 | 533.6014 | 521.1575 |
| 40 | 428.9572 | 427.1220 |
| 45 | 495.5883 | 490.3905 |
| 50 | 568.9628 | 516.8121 |
| 55 | 633.8514 | 526.2094 |
| 60 | 650.1903 | 497.3227 |
| 65 | 744.1811 | 544.4588 |
| 70 | 919.7167 | 580.1024 |

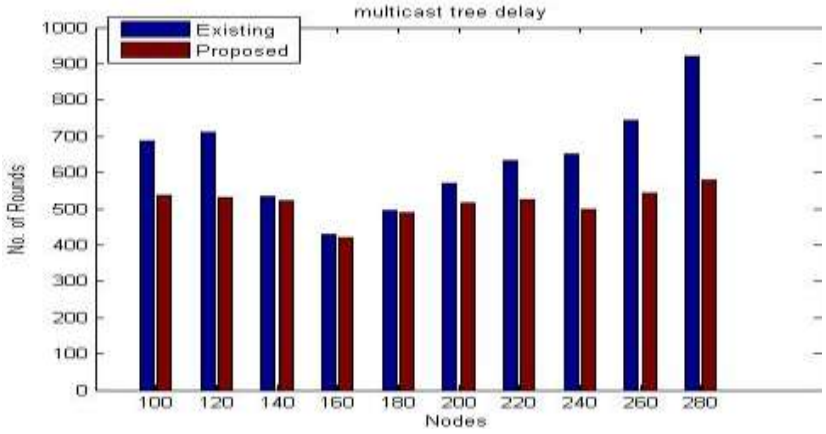


**Fig 4: Delay Analysis**

Fig 4 represents that delay of proposed technique is less as compared to existing technique. Therefore, proposed work outperforms the existing technique.

### 4.4 MULTICAST TREE COST

The total cost of the tree is defined as sum of the cost of all links in that tree. Table represents the execution time evaluation of proposed technique as compared to existing technique.

**Table 4: Multicast Tree Cost Evaluation**

| No. of nodes | Existing | Proposed |
|---|---|---|

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| | | |
|---|---|---|
| 20 | 438.5070 | 389.0169 |
| 25 | 508.1668 | 431.3477 |
| 30 | 588.2440 | 459.2248 |
| 35 | 477.8639 | 385.5913 |
| 40 | 545.0253 | 447.8470 |
| 45 | 620.6920 | 464.6433 |
| 50 | 689.5123 | 464.5456 |
| 55 | 705.4623 | 472.0122 |
| 60 | 793.2702 | 510.2699 |
| 65 | 970.2726 | 550.1686 |
| 70 | 438.5070 | 389.0169 |
| 75 | 508.1668 | 431.3477 |

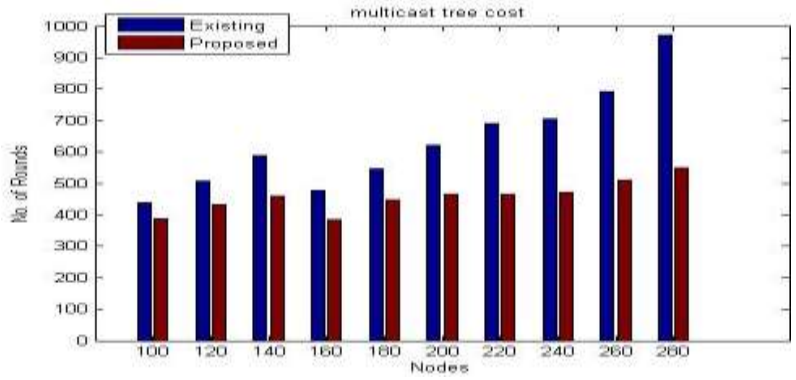


**Fig 5: Tree Cost Analysis**

Fig 5 represents that tree cost of proposed technique is less as compared to existing technique. Therefore, proposed work outperforms the existing technique.

## V. CONCLUSION

Mobile ad-hoc networks can operate in a standalone fashion or may be attached with a larger network including the Internet. Mobile ad-hoc networks can turn the dream of getting connected "anywhere and at any time" into reality. Typical application examples add a disaster recovery or perhaps a military operation. Not bound to specific situations, these networks may equally show better performance in other places. These services frequently necessitate the fundamental system to offer multicast facility. The multicast describes the distribution of structures from just a unitary node to amount of destinations. These real-time services have a stringent necessity of QoS factors like bandwidth, delay, jitter etc. to make certain clean, consistent, and fair sign to the receivers. The experimental result has clearly shown that the proposed technique outperforms over the available techniques.

## VI. FUTURE WORK

This work has not considered any improvement while selecting the cluster heads, so in near future we will improve the cluster head selection further by using appending some other features in it, like node degree (i.e. it can represent how many nodes), cluster head to cluster head distance and also reliability factor. This work has not considered any failures in paths so in near future path values will also be considered.

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